Green Infrastructure:
Rethinking Landscapes & Streetscapes

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ASU Tree & Shade Summit

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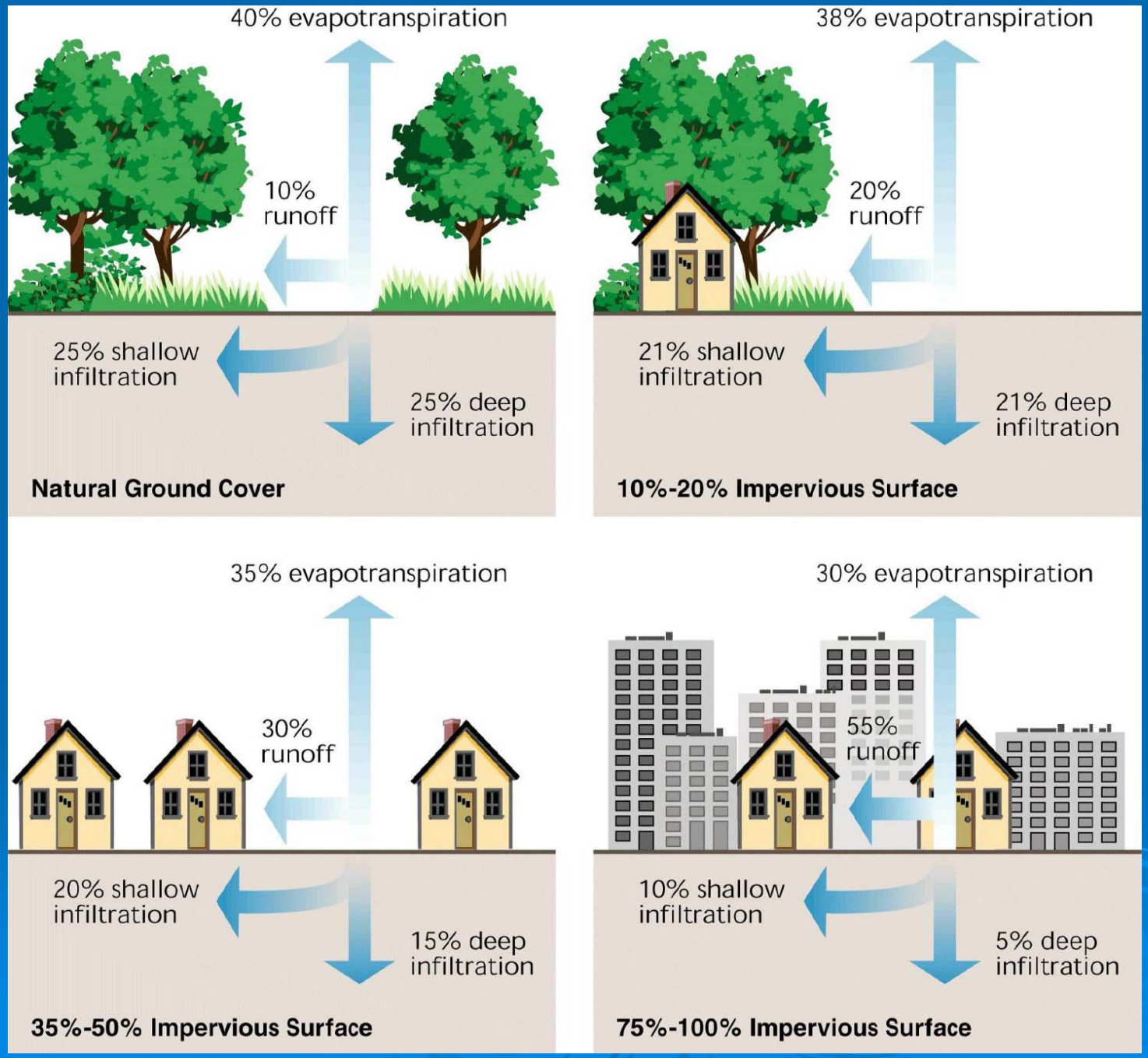
Contaminants in Urban Stormwater Runoff

- Sediment
- Oil, grease & toxic chemicals from motor vehicles on roads, parking lots, and driveways
- Pesticides & nutrients from lawns & gardens
- Viruses, bacteria, and nutrients from pet waste and failing septic systems
- Heavy metals from roof shingles, motor vehicles, and other sources
- Thermal pollution from dark impervious surfaces such as streets & rooftops
- Trash & debris


40% evapotranspiration
10% runoff
25% shallow infiltration
25% deep infiltration
Natural Ground Cover
38% evapotranspiration
20% runoff
21% shallow infiltration
21% deep infiltration
10%-20% Impervious Surface
35% evapotranspiration
30% runoff
20% shallow infiltration
15% deep infiltration
35%-50% Impervious Surface
30% evapotranspiration
55% runoff
10% shallow infiltration
5% deep infiltration
75%-100% Impervious Surface

Green Infrastructure Strategies

- Amended soils
- Impervious cover removal
- Bioretention
- Permeable pavements
- Green roofs
- Cisterns & rain barrels
- Trees and expanded tree boxes
- Reforestation and restoration
- Redevelopment
- Infill development
- Alternative parking and street designs
- Water conservation

3-Scale Approach to Stormwater Management

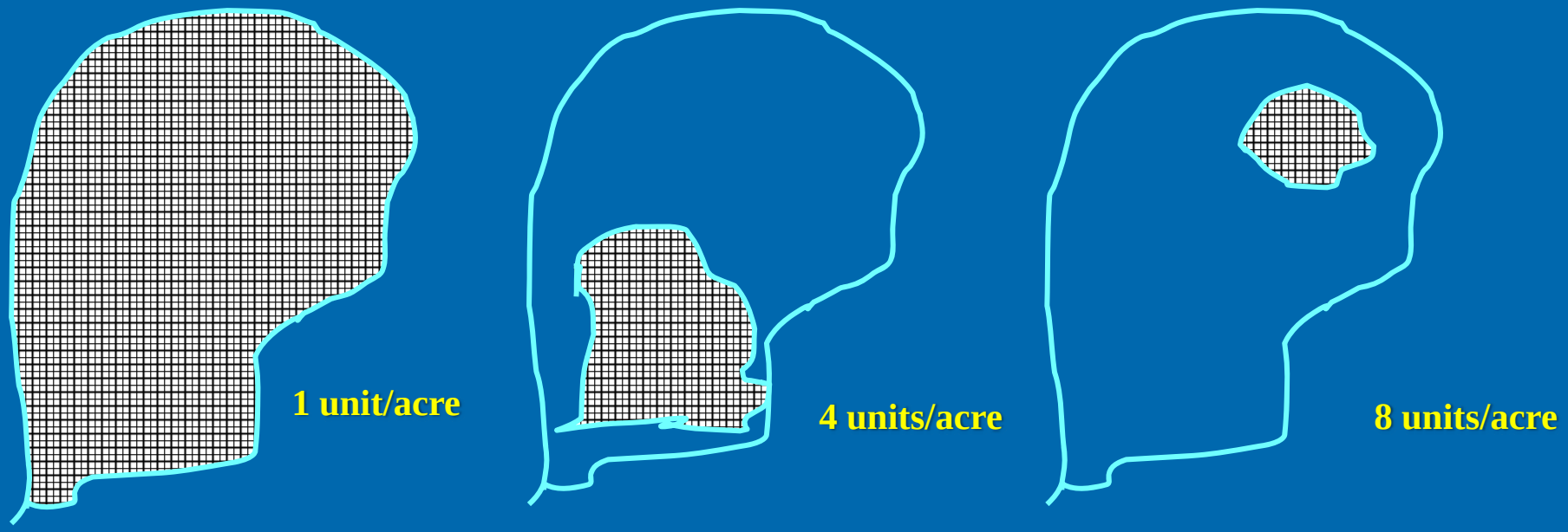
Region or Watershed

Neighborhood

Site

Watershed Scale

Accommodating 10,000 units on a 10,000 acre watershed at different densities



10,000 houses on 10,000 acres produce <u>187 million ft^3 /yr</u> stormwater runoff

Site: 20% impervious
Watershed: 20% impervious

10,000 houses on 2,500 acres produce 62 million ft^3 /yr stormwater runoff

Site: 38% impervious
Watershed: 9.5% impervious

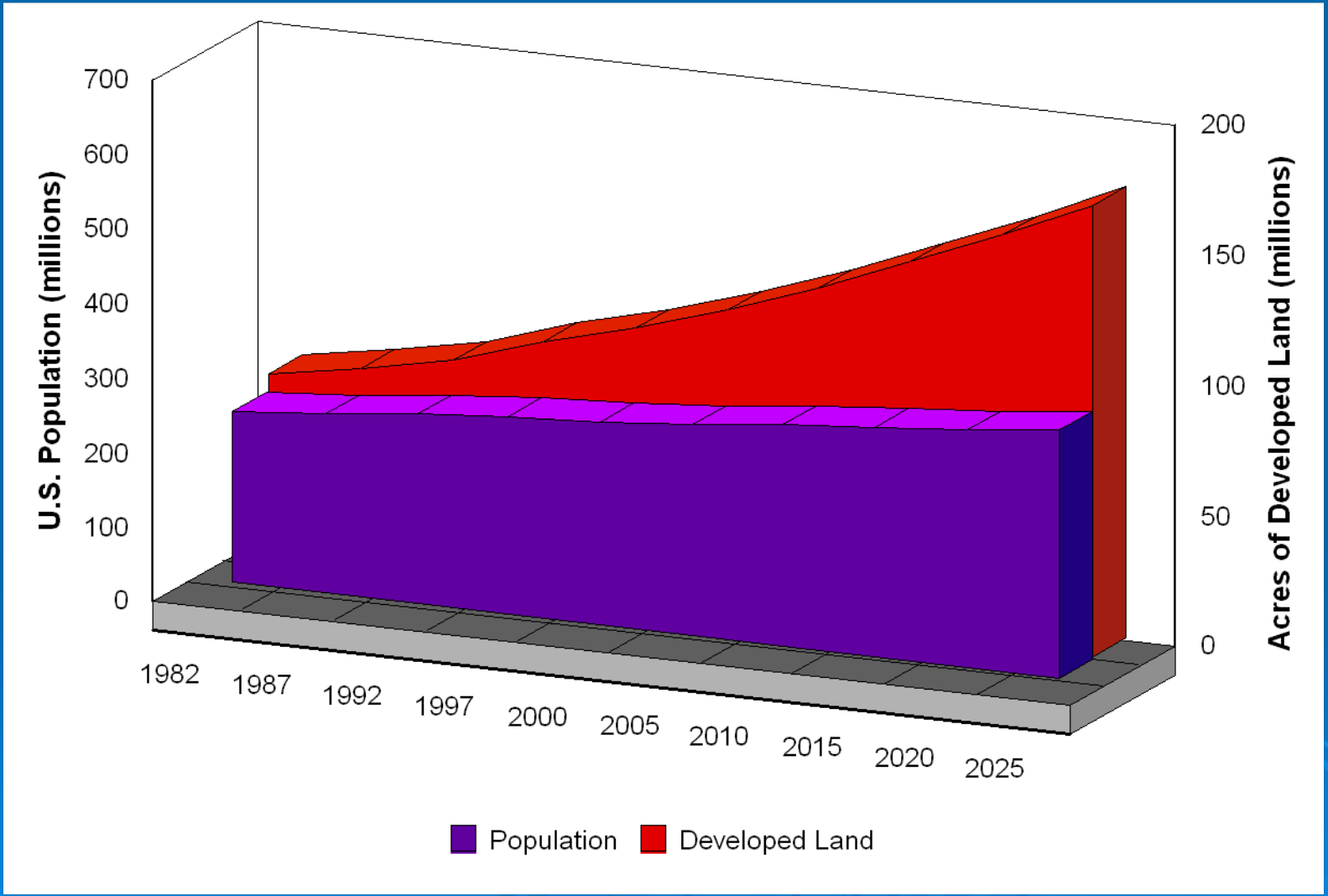
10,000 houses on 1,250 acres produce <u>49.5 million ft^3 /yr</u> stormwater runoff

Site: 65% impervious
Watershed: 8.1% impervious

The lower density scenario creates more run-off and consumes 2/3 more land that the higher density scenario

Watershed Scale

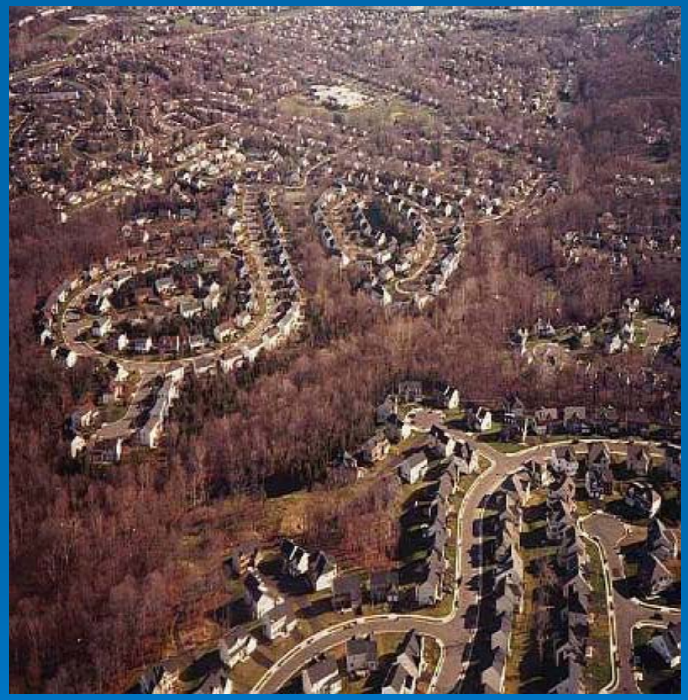
We're consuming land faster than our population is growing.



Source: Data and extrapolations from National Resources Inventory 2001; U.S. Census Bureau 2000.

Neighborhood Scale

Neighborhood design has a direct effect on the amount of impervious surface



Housing like this…

…is, by design, served by retail and roads like this

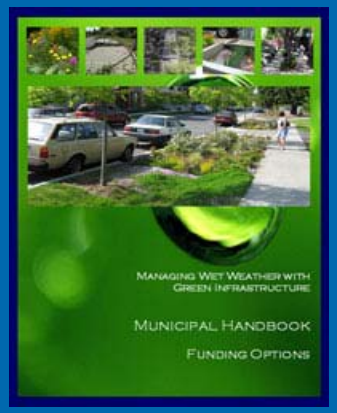
LID Features in Renewed Municipal Stormwater Permits

- EPA Region 9 supports clear, measurable, enforceable criteria (e.g., Design Storm volume) for New Development/Significant Redevelopment Projects
  - Example: require new development & redevelopment projects to retain up to the 85th percentile storm event using LID techniques
  - Where site constraints make achievement of LID Performance Criteria technically infeasible, developer may comply by using LID to address stormwater flow at another property in the same watershed.

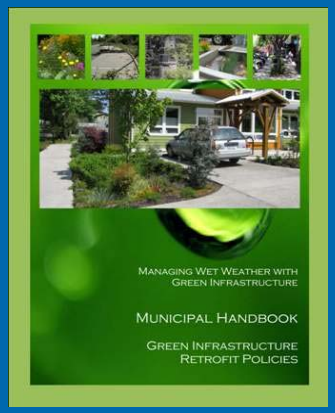
See www.epa.gov/region9/water/lid/ for permit requirements endorsed by Region 9

EPA Resources

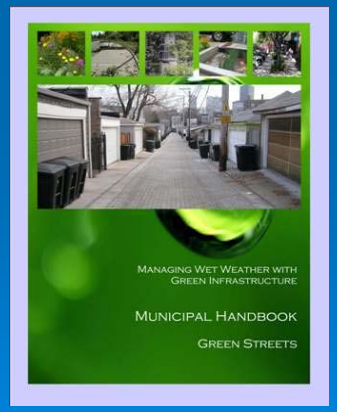
Green Infrastructure Municipal Handbook



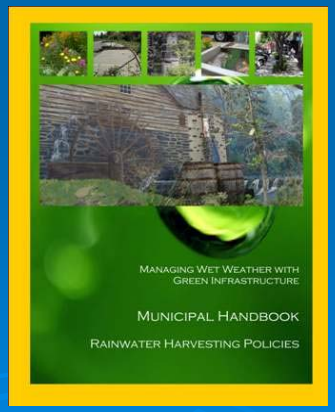
Funding



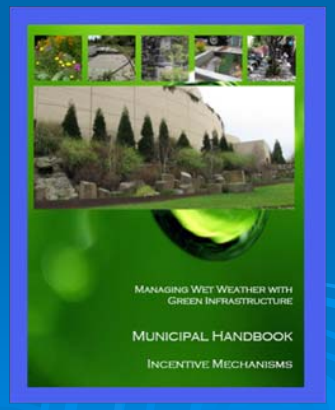
Retrofit Policies



Green Streets



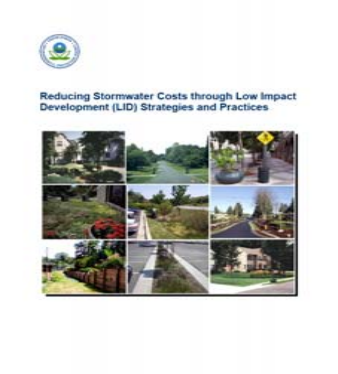
Rainwater Harvesting Policies



Incentive Mechanisms

http://cfpub.epa.gov/npdes/greeninfrastructure/munichandbook.cfm

Cost Case Studies



Project	Estimated Conventional Development Cost	Actual LID Cost	Cost Savings	Percent Savings
2nd Ave SEA Street (WA)	$868,803	$651,548	$217,255	25%
Auburn Hills (WI)	$2,360,3385	$1,598,989	$761,396	32%
Bellingham City Hall WA)	$27,600	$5,600	$22,000	80%
Bellingham Bloedel Donovan Park (WA)	$52,800	$12,800	$40,000	76%
Gap Creek (AS)	$4,620,600	$3,942,100	$678,500	15%
Garden Valley (WA)	$324,400	$260,700	$63,700	20%
Kensington Estates (WA)	$765,700	$1,502,900	- $737,200	- 96%
Laurel Springs (WI)	$1,654,021	$1,149,552	$504,469	30%
Mill Creek (IL)	$12,510	$9,099	$3,411	27%
Prairie Glen (WI)	$1,004,848	$599,536	$405,312	40%
Somerset (MD)	$2,456,843	$1,671,461	$785,382	32%
Tellabs Corporate Campus (IL)	$3,162,160	$2,700,650	$461,510	15%

EPA Funding

- Clean Water State Revolving Funds
  - State managed
  - 20% “green reserve”
- Nonpoint Source Funds (CWA 319)
  - State managed
- Targeted Watershed Grants
  - 2011 award to River Network
  - Local capacity-building focus

Other Funding Opportunities

- Housing & Urban Development
  - Community Development Block Grants
- USDA Forest Service
  - Urban and Community Forestry Challenge Grants

Tools

National Green Values Calculator

http://greenvalues.cnt.org/national/calculator.php

Long-Term Hydrologic Impact Assessment Model

https://engineering.purdue.edu/mapserve/LTHIA7/

The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits

http://www.cnt.org/natural-resources/

Ancillary Benefits

- Increased property values
- Higher lot yield
- Groundwater recharge
- Habitat improvement
- Reduced downstream flooding
- Improved air quality
- Lower water supply treatment costs
- Lower urban heat island effect
- Public health & well-being
- Green jobs

Urban Infiltration Potential

Infiltrating urban stormwater to recharge groundwater

LA Water Augmentation Study

Findings:

- Potential for an additional 384,000 acre ft. annually
- Enough to supply drinking water for 1.5 million people
- $311 million annual value

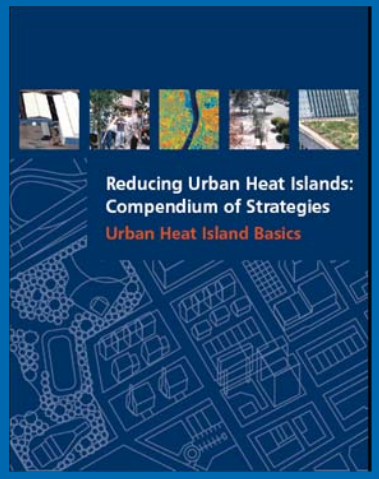
Urban Heat Island Mitigation

Impacts:

- Increased energy demand/use
- Increased smog formation
- Increased GHGs
- Thermal pollution to water bodies
- Human health – incidents of heat stroke & heat-related mortality

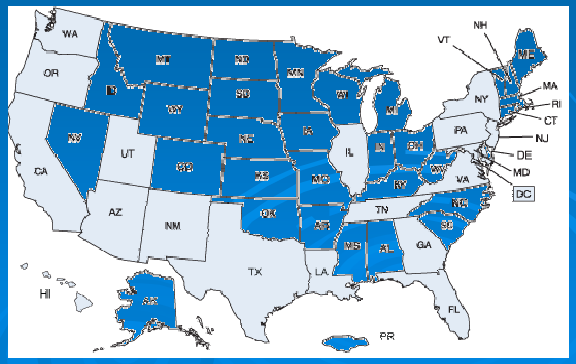
- Trees & Vegetation
- Green Roofs
- Cool Roofs
- Cool Pavements

EPA's Urban Heat Island Reduction Program



- Compendium of Strategies
- Webcasts
  - Stakeholders from around the Country inform each other of their urban heat-island related work
    - *Measuring and Modeling Urban Heat Islands*
    - *Heat Island Impacts (e.g., air, water quality)*
    - *Mitigation (e.g., strategies, technologies, activities)*

  http://www.epa.gov/heatisland/resources/webcasts.htm
- Database "Where you live"
  - Local and Statewide initiatives
- Listserve to disseminate info



Widening the Spectrum…

Sacramento County's River-Friendly Landscaping Program

Seven Principles

- Features a whole systems approach

Examples:

- Use local plants
- Keep plant debris on-site
- Protect soil from compaction
- Reduce irrigation needs
- Use tree shading to conserve energy
- Apply Integrated Pest Management
- Reduce landscape equipment use

- Awarded an EPA Climate Showcase Communities Grant
  - Greenhouse Gas Reductions calculator
  - Standards for urban parks & Turf Demo project
  - Expanded "Green Gardener" training
  - Residential outreach campaign

What is a sustainable street?

Source: Nevue Ngan Associations

Green Infrastructure
-bioswales
-filter strips & buffers
-permeable pavement
-curb extensions

Complete Streets
-pedestrian & bicycle mobility
-transit-oriented development
-narrower streets
-minimum setbacks

Urban tree canopy
-optimized for stormwater control, air quality, urban heat island reduction, energy reduction in buildings, etc.

Source: Asphalt Recycling & Reclaiming Assoc.

Source: City of Chicago

Source: Arizona-Sonora Desert Museum

Source: DOE Gateway Demonstration Results

Pavement mixes & practices
-reuseable & recycled materials in concrete & asphalt
-pavement reclamation technologies

Cool pavements
-high solar reflectance

Xeriscaping
-use of compost
-low water-use plants
-eliminate pesticides
-limited turf

LED street lighting

City of Chicago Sustainable Streetscape

Cermak/Blue Island Project – retrofitting an existing block

Sustainability Objective	Specific Goal
Stormwater Management	*80% rainfall diversion rate, 2/3 rainwater catchment*
Water Efficiency	*Eliminate potable water use for irrigation, native, drought-tolerant plants in landscaping*
Transportation	*Improve pedestrian mobility, add new bike lanes*
Energy Efficiency	*Reduce energy use by 40% below the average street; reflective surfaces, recycled aggregates, regionally extracted & manufactured materials*
Recycling	*90% recycling of construction waste, minimum 10% recycled content of total materials value*
Urban Heat Island	*Reduce ambient temps with reflective pavements, roadway coatings, landscaping, permeable pavements*
Education, Beauty & Community	*Public outreach on sustainable design, community gathering space, interaction with nature*
Commissioning	*Monitoring results/effectiveness*

Cost Results: 20% less per block than the average cost

More Information

www.epa.gov/greeninfrastructure

www.epa.gov/region9/water/lid/

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"Green infrastructure is a fiscally responsible and environmentally sustainable answer to today's water challenges. It manages stormwater by treating it like a resource – and it works with nature, rather than against it."

EPA Administrator Jackson, August 2010